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(54) **Lamp reflector**

(57) Lamp reflector of a polymer composition that 0.3 - 15 wt. % of a thermally conductive material. In a preferred embodiment the composition comprises polyethylene terephthalate (PET) and expanded graphite as conductive material.

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Description

[0001] The invention relates to a lamp reflector of a polymer composition. Examples of lamp reflectors are reflectors in headlamps or fog lamps for motor vehicles and reflectors for energy saving lamps.

[0002] Polymer compositions are widely used for producing for example headlights of cars to replace metal parts. A problem, however, with polymer compositions is that they give rise to fogging. Fogging is the deposition of volatile compounds, originating from the polymer composition and volatilised by the heating of the lamp under operating conditions, on cold spots such as the lens of the headlight.

[0003] Measures applied to reduce fogging include, for example, exclusion of solvents in the composition; thinner designs for the moulded parts, thus reducing the amount of material contributing to fogging; and insulating the part by applying a coating. Another solution relates to special designs of the reflector, as a result of which an internal air flow is induced when the vehicle is moving and the material contributing to fogging is guided away from the critical part, thus resulting in reduced deposition of the material contributing to fogging on that part. Fogging is undesirable because it reduces the transparency of for example the lens of a headlamp and reduces the yield of the light. In EP-1627005 a thermoplastic polyester reflector has been proposed that comprises a polyester composition that contains a low amount of dimer, obtained by giving the composition a heat treatment. There is still need for lamp reflector with further reduced fogging.

[0004] This object has been achieved with a lamp reflector of a polymer composition according to the invention, wherein the composition comprises 0.3 - 15 wt. % of a thermally conductive material.

[0005] Surprisingly fogging is reduced.

[0006] Examples of polymers that may be used in the polymer composition include unsaturated polyester, polycarbonate, liquid crystal polymers, polyetherimide and polyphenylene sulphide, polyamides.

[0007] The polymer that is used in the composition for the lamp reflector according to the invention suitably is thermoplastic polyester. Preferably the thermoplastic polyester is semi-crystalline polyester. Said semi-crystalline polyester is generally derived from at least one aromatic dicarboxylic acid or an ester-forming derivative thereof and at least one aliphatic, cycloaliphatic or aromatic diol, and includes homo- as well as copolymers. Examples of suitable aromatic diacids include terephthalic acid, isophthalic acid, naphthalene dicarboxylic acid, biphenyl dicarboxylic acid, etc., with terephthalic acid being preferred. Suitable diols include alkylane diols, hydroquinone, dihydroxyphenyl, naphthalene diol. Alkylane diols, like ethylene diol, propylene diol, 1,4-butylene diol, neopentyl diol, and cyclohexane dimethanol are preferred. These semi-crystalline polyesters may further comprise small amounts of, for example, aliphatic dicar-

boxylic acids, monofunctional alcohols and / or carboxylic acids and three or higher functional alcohols and / or carboxylic acids, provided that these polyesters remain melt-processable. Preferably, the content of other monomers in these polyesters is below 20 wt. %, more preferably below 10 wt. %, even more preferably below 5 wt. %, relative to the total weight of the polyester, to ensure the semi-crystallinity of the polyester.

[0008] Suitable thermoplastic polyesters that may be used in the composition of the lamp reflector according to the invention are, for example, polyalkyleneterephthalates, polyalkylene naphthalates, and polyalkylene bisbenzoates and any copolymers and any mixtures thereof. These polyesters can be derived from alkane diols and, respectively terephthalic acid, naphthalene dicarboxylic acid and 4,4'-diphenyldicarboxylic acid.

[0009] Suitably, the polyalkyleneterephthalate is poly(1,4-cyclohexanedimethylene terephthalate) (PCT) or a poly(alkylene terephthalate) based on an aliphatic diol with 2 to 6 carbon atoms, like polyethyleneterephthalate (PET), polytrimethyleneterephthalate (PTT), and poly(1,4-butylene terephthalate) or simply called polybutylene terephthalate (PBT).

[0010] Suitable poly(alkylene naphthalate)s include polyethylenenaphthalate (PEN) and polybutylenenaphthalate (PBN). Suitable polyalkylene bisbenzoates include polyethylenebisbenzoate (PEBB) and polybutylenebisbenzoate (PBBB). Suitably, these semi-aromatic thermoplastic polyesters comprise a minority content of another dicarboxylic acid or diol.

[0011] Of these polyesters, PET and PBT, and any mixture or copolymer thereof is preferred. More preferably the thermoplastic polyester is PET.

[0012] The thermally conductive material preferably has a thermal conductivity λ (W/m.K) that is preferably at least 5 times, more preferably at least 25 times and even more preferably at least 100 times higher than the thermal conductivity of the polymer composition but without the thermally conductive material.

[0013] Thermally conductive materials include for example, aluminium, aluminium oxide, copper, magnesium, magnesium oxide, brass, silicon nitride, aluminium nitride, boron nitride, zinc oxide, graphite, preferably expanded graphite, PITCH-based carbon fibres and the like. Mixtures of such thermally conductive materials are also suitable. The thermally conductive material may be in the form of granular powder, particles, whiskers, short fibres, flake, platelet, rice, strand, or spherical-like shapes or any other suitable form. The thermally conductive material is preferably present in an amount between 1 and 10 wt% with respect to the total polymer composition, more preferably between 2 and 7 wt% with respect to the total polymer composition.

[0014] Preferably, the thermally conductive material is expanded graphite, as this is highly effective and also gives a smooth surface for the reflector.

[0015] Good results have been obtained if the polymer compositions contains a montanate wax as mould re-

lease agent, preferably in a amount of up to 1 wt. %.

[0016] Preferably the composition contains 10 - 60 wt. % of chopped glass fibers.

[0017] Surprisingly a further decrease in fogging has been obtained if the thermoplastic polyester composition has been subjected to a solid state post condensation process. A solid state post condensation (SSPC) process makes it possible to produce the composition according to the invention in a first step with polyester having a relatively low molecular weight and consequently a relative low viscosity. Because of the relative low viscosity it is easy to mix the polyester and the thermally conductive material. In case the thermally conductive material is a carbon fibre, the fibre breakage is reduced during mixing of the fibres with the molten polyester. After the mixing of the conductive material with the molten polyester, for example in an extruder, the so obtained mixture may be granulated and cooled down.

[0018] Thereafter in a second step the actual solid state post condensation is carried out to increase the molecular weight of the polyester by subjecting the polymer composition to a heat-treatment, preferably at a temperature close to, but below the melting point of the polyester, under reduced pressure or a flow of an inert gas. If the polyester is PET, the heat treatment preferably is carried out at a temperature between 160°C and 245°C, more preferably between 170°C and 240°C. The advantage of a higher temperature is that the time needed for obtaining the RSV is shorter.

[0019] Preferably the inert gas atmosphere has a pressure of less than 10 kPa, more preferably less than 1 kPa, even more preferably less than 500 Pa. A lower pressure has the advantage that the required molecular weight is obtained in shorter time. This allows a more efficient production process with a higher yield, without the need of extending the production installation.

[0020] The SSPC of the thermoplastic polyester composition may be carried out by any mode and in any apparatus suitable for that purpose. The process may suitably be carried out as a batch process, for instance in a tumble dryer, or as a continuous process, for instance in a moving bed reactor.

[0021] Suitably the reflector according to the invention is a reflector for a head lamp or a fog lamp for a car.

[0022] Preferably the reflector is a reflector for a fog headlight of a car, because this reflector is very sensitive for the occurrence of fogging. In this case the reflector is often part of the housing or is the housing of the fog lamp.

Experiments

Materials used.

[0023]

PET, polyethylene terephthalate having a relative viscosity (RSV) of 1.34.

NA: nucleating agent, Sodium benzoate, delivered

by Univar Benelux.

GF: glass fibre 1, ChopVantage™ HP 3786, delivered by PPG Industries Fibre Glass.

MRA : Mould release agent, montanate wax Licolub™ WE 40, delivered by Clariant

EG: expanded graphite, Timrex™ C-therm 001, delivered by Timcal Ltd.

Preparation of PET composition by compounding.

[0024] The polymer compositions were prepared on a ZE40A UTX twinscrew extruder from Berstorff. Barrel temperature was set at 260 - 310°C, screw speed was 300 RPM and yield was 170 kg/hour. Components such as PET, nucleating agent and mould release agent were dosed to the hopper as a pre-blend. The glass fibers and the expanded graphite component were introduced via a side-feeder into the polymer melt. Extruded strands were cooled in water and granulated.

SSPC of the PET composition

[0025] Heat treatment of the polymer composition was performed in a tumble-drier 100 litre unit. The drier was charged with 25 kg PET granules and pressure was reduced to 80 mbar, vented with pure, dry nitrogen and temperature raised initially to 120 °C. After 1 hour at 120 °C pressure was reduced to 4 mbar and temperature was raised to 135 °C. After 1 hour temperature of the granules was raised to 205 °C, while pressure was kept at 4 mbar and vented with nitrogen. The granules were maintained at these conditions for between about 10 and 34 hours until a target RSV 1.43 had been reached. After this period, the samples were cooled down to room temperature.

[0026] The relative solution viscosity (RSV) was determined in a solution of 0.5 gram of polymer in 100 ml of dichloroacetic acid at 25°C (method based upon ISO 1628-5).

Comparative experiment A.

[0027] A composition was prepared comprising 35 wt. % of glass fibres, 0.10% Sodium benzoate, and 0.35 wt. % of Montanate wax, the balance being PET. The composition was subjected to solid state post condensation (SSPC). Head lamp reflectors of the material are produced by injection moulding. The reflector, together with a lamp and a lens are mounted in a test facility and tested until fogging appeared at the lens.

Example I.

[0028] As comparative experiment A, but with 5% expanded graphite included. At the moment clear occurrence of fogging is observed at the head lamp of comparative experiment A, no fogging is observed at all at the lamp of the example.

Claims

1. Lamp reflector of a polymer composition, **characterised in that** the composition comprises 0.3-15 wt. % of a thermally conductive material. 5
2. Lamp reflector according to claim 1, wherein the polymer composition contains polyethylene terephthalate (PET), polybutylene terephthalate (PBT) or a mixture thereof. 10
3. Lamp reflector according to claim 1, wherein the polymer composition contains polyethylene terephthalate (PET). 15
4. Lamp reflector according to any one of claims 1-3, wherein the composition comprising 1.0 - 10 wt. % of thermally conductive material.
5. Lamp reflector according to any one of claims 1-4, wherein the thermally conductive material is expanded graphite. 20
6. Lamp reflector according to any one of the preceding claims, **characterised in that** the lamp reflector is a reflector for a headlamp or a fog lamp. 25
7. Lamp reflector according to any one of the preceding claims, **characterised in that** the reflector is a reflector for a fog headlamp. 30

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EUROPEAN SEARCH REPORT

Application Number
EP 12 15 5782

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<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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